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BOTANY—*New grasses from China.*[1] Y. L. KENG,[2] U. S. National Herbarium. (Communicated by A. S. HITCHCOCK.)

During the course of my studies in preparation of a monograph on the grasses of China, I have found two undescribed species in the Andropogoneae, and one new *Arundinella*. So little work has hitherto been done on the Chinese grasses that it is probable that as my study progresses further unknown species will be brought to light. I take pleasure in expressing my appreciation of the assistance given me by Prof. A. S. Hitchcock, Mrs. Agnes Chase, and their colleagues.

Ischaemum lanceolatum Keng, (Sect. *Polliniopsis*) sp. nov.

Perenne, caespitosum; culmi erecti, ad 40 cm. alti, graciles, multinodiis, nodis inferioribus confertis ramosi, iis 2 superioribus longe remotis; vaginae arctae, superiores internodiis breviores, inferiores iis longiores, equitantes, superne carinatae, glabrae vel apice pubescentes; ligula membranacea, firma, 2–3 mm. longa, saepe 2-partita, in vaginam decurrens; laminae lanceolatae, 3–8 cm. longae, 6–10 mm. latae, basi subito v. sensim angustatae, acuminatae, summa multo abbreviata v. subulata, patentissimae, rigidae, glabrae, virides v. glaucescentes, marginibus scabrae; racemi in apice culmi ramorumque 2–3-ni, 3–6 cm. longi, subgraciles, fulvi v. purpurascentes; rhacheos articuli spiculis sessilibus paulo vel dimidio breviores, leviter plano-convexi, ciliati; spiculae sessiles lanceolato-oblongae, 5–6 mm. longae, callo obtuso pilis circ. 1 mm. longis dense barbato; gluma prima chartaceo-membranacea, 4–7-nervis, medio distincte sulcata, apice integra v. bidenticulata; gluma secunda 3-nervis, primam paulo superans, acuta; lemma inferius oblongum, hyalinum, 1-nerve v. enerve; ejus palea brevior, binervis; lemma superius in $\frac{2}{3}$ superiore bifidum, inferne 3-nerve, membranaceum, e sinu aristam perfectam 8–10 mm. longam emittens; spiculae pedicellatae iis sessilibus similes v. rudimentariae, glumis primis 5–7-nervibus, secus nervos scaberulis; pedicelli articulis similes sed breviores.

Perennial; culms tufted, suberect, up to 40 cm. high, multinoded, branched

[1] Received March 17, 1931.

[2] Fellowship student of the Rockefeller Foundation, from the National Central University, Nanking, China.

below, slender and wiry above; sheaths tight, equitant at the lower nodes, keeled above, striate, glabrous or pubescent at the junction with the blades; ligule membranaceous, firm, 2–3 mm. long, usually 2-lobed, decurrent into the margins of the sheaths; blades lanceolate, 3–8 cm. long, 6–10 mm. wide, acute or acuminate, constricted at base, glabrous, rigid, glaucous, the margins scabrous, the uppermost much reduced or subulate; racemes 2–3-nate, erect, 3–6 cm. long, slender, brownish or purplish; rachis joints compressed, ciliate, subequalling or ½ shorter than the sessile spikelets; sessile spikelets 5–6 mm. long, lanceolate-oblong, the callus obtuse, densely bearded with hairs about 1 mm. long; first glume chartaceo-membranaceous, 4–7-nerved, distinctly grooved between the median nerves, entire or bidentulate, the keels scaberulous above; second glume 3-nerved, acute, a little longer than the first; lower lemma oblong, hyaline, 1-nerved or nerveless, pilose, with a shorter 2-nerved

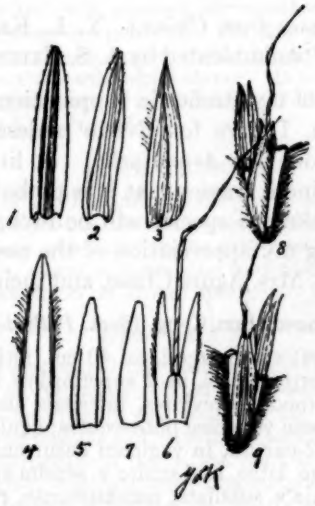

Fig. 1. *Ischaemum lanceolatum* Keng.—1–2, dorsal and ventral views of first glume, × 5; 3, side view of second glume, × 5; 4–5, lower lemma and its palea, × 5; 6–7, upper lemma and its palea, × 5; 8–9, views of a single joint and the binate spikelets, × 3½.

palea; upper lemma 2-cleft to below the middle, the lobes acute, pilose, the portion below the insertion of the awn membranaceous, 3-nerved; awns 8–10 mm. long, geniculate about in the middle; pedicellate spikelets similar to the sessile or rudimentary, shortly awned or awnless, the first glume 5–7-nerved, the nerves scaberulous; pedicels ciliate as in the joints but usually shorter.

Type in U. S. National Herbarium, no. 1501523, collected from Yunnan, China, altitude 2800–3000 meters, by E. E. Maire (no. 7039); duplicate type in the Herbarium of the University of California, no. 388785 (ex-herb. G. Bonati).

This species is apparently an intermediate form between *Eulalia* (section *Leptatherum*) and *Ischaemum*, belonging to Hackel's section *Polliniopsis* or Stapf's *Coelischaemum* of the latter genus. It approaches the Indian species *Ischaemum petiolare*, but differs in the more slender and smaller habit, much shorter and subsessile blades, and in the fewer racemes.

Rottboellia laevispica Keng, (subgen. *Coelorachis*) sp. nov.

Planta annua; culmi 1 m. v. plus alti, 3 mm. crassi, striati, glabri, basi plus minusve geniculati, nodis inferioribus radicantes, ramis floriferis erectis, solitariis, simplicibus, uninodiis, lateri complanato culmi appressis; vaginae saltem inferiores laxae, superne leviter carinatae, laeves v. cum tuberculis scabrae, inferiores internodiis longiores, superiores iis breviores, apice interdum sparse barbatae; ligula rotunda, brunneo-membranacea, 0.5–1 mm. longa, ciliata; laminae lineari-lanceolatae, 15–40 cm. longae, 8–16 mm. latae, acuminatae, basi angustatae v. subrotundae, scaberulae v. inferne laeves, glabrae v. superne versus basin sparse papillato-pilosae, virides v. saepe glaucescentes, flaccidae, margine serrulato-scabrae; racemi ad 15 cm. longi, 2–3 mm. crassi, laeves, robusti, versus apicem attenuati, demum longe exserti; articuli virides v. brunnescentes, plerumque pedicellos et spiculas sessiles aequantes, fragiles, apice valde excavati; spiculae sessiles biflorae, pallide virides v. brunnescentes, callo glabro circ. 1 mm. longo e gluma prima sulco membranaceo separato 7–10 mm. longae; gluma prima lanceolato-oblonga, chartaceo-membranacea, dorso plana v. nervis elevatis striata, carina infra apicem angustissime alata et supra medium scaberula; gluma secunda primam aequans, 9–11-nervis, acuta, carina superne scaberula; lemma inferius glumam primam aequans, membranaceum, 3–5-nerve, palea rigidiori binervi, flore masculino, antheris 2–3 mm. longis; lemma superius paulo brevius, 3-nerve, palea angustiore, binervi; styli distincti, stigmata aequantes; spiculae pedicellatae plerumque ad glumam primam minutam reductae, rarissime basi racemi evolutae et fertiles, pedicellis tenuibus, planis, articulo arctissime appressis v. superne liberis.

Annual; culms 1 m. or more high, 3 mm. thick, striate, flat or channelled on one side, glabrous, more or less geniculate and rooting at the lower nodes, the floriferous branches erect, appressed to the flat or channelled side of the culm, 1-noded, solitary and simple; sheaths, at least the lower ones, loose, slightly keeled above, smooth or roughish with papillae, the lower longer, the upper shorter than the internodes, sometimes sparsely bearded at apex; ligule rounded, brownish-membranaceous, ciliate, 0.5–1 mm. long; blades linear-lanceolate, 15–40 cm. long, 8–16 mm. wide, acuminate, the base narrowed or somewhat rounded, scaberulous or smooth beneath, glabrous or sparsely papillose-pilose towards the base above, green or often glaucescent, flaccid, the margins serrulate-scabrous; racemes finally long-exserted, up to 15 cm. long, subcylindric, 2–3 mm. thick, smooth, stout, narrower with imperfect spikelets towards the apex; rachis green or brownish, fragile, the joints mostly equalling the pedicels and sessile spikelets, strongly hollow towards the base, the summit deep concave; sessile spikelets 7–10 mm. long, 2-flowered, pale-green or brownish; callus glabrous, about 1 mm. long, separated from the first glume by a membranaceous furrow; first glume lanceolate-oblong, chartaceo-membranaceous, dorsally flat or striate with slightly elevated nerves, the keels narrowly winged at apex and scaberulous above the middle; second glume as long, chartaceous, 9–11-nerved (the nerves netted above when seen under transmitted light), acute, the keel scaberulous above; lower lemma as long as the first glume, membranaceous, 3–5-nerved, with a firmer but 2-nerved palea, usually staminate; upper lemma a little shorter than the lower, 3-nerved, with a narrower 2-nerved palea; anthers 2–3 mm. long; styles distinct, as long as the stigmas; pedicellate spikelets mostly rudimentary, rarely well-developed and fertile at base of the raceme; pedicels thin, flat, broad at the base, closely appressed to the rachis joints or free above.

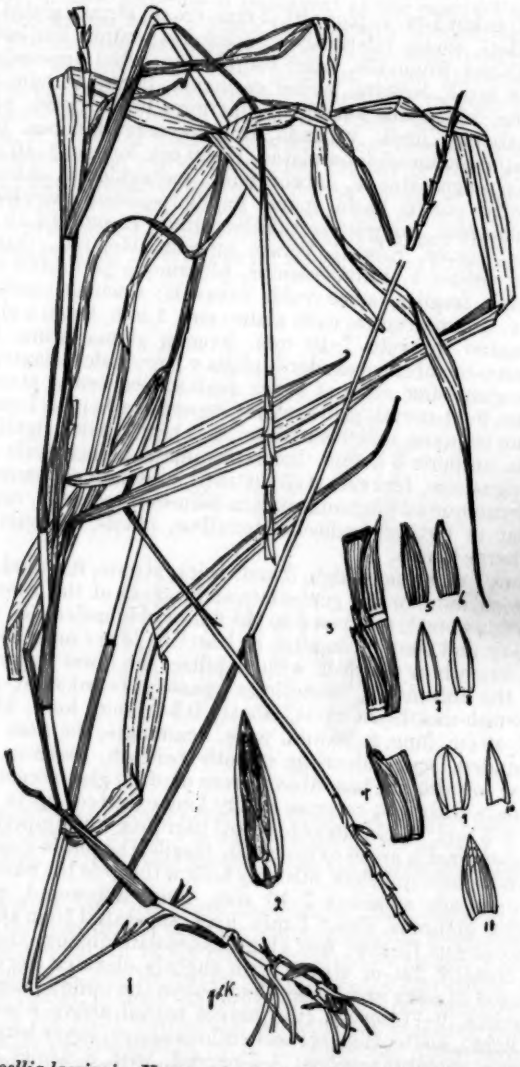

Fig. 2. *Rottboellia laevispica* Keng.— 1, plant, $\frac{1}{4}$ natural size; 2, sessile spikelet with first glume removed, showing the pistil, occasionally seen in the lower floret, × 3; 3–4, views of joints with sessile and pedicellate spikelets, × 1½; 5–6, dorsal and ventral views of the first glume, × 1½; 7–8, lower lemma and its palea, × 1½; 9–10, upper lemma and its palea, × 1½; 11, inner surface view of the second glume under transmitted light, × 1½.

Type in U. S. National Herbarium, no. 1105524 and 1346303, collected on prairie, West of Chu-chow, Anhwei, altitude 160 meters, September 24, 1921, by J. B. Griffin and A. N. Steward (no. 996); the same species collected in shady woods, South of I-shing, Kiangsu, August 21, 1929, by Y. L. Keng (no. 2550).

A distinct species of the subgenus *Coelorachis*, probably closely related to *R. exaltata* L. f., from which it is distinguished by the smooth green or brownish racemes, lanceolate-oblong sessile spikelets, and the thinner pedicels mostly equaling the rachis joints. It differs also in the glabrous sheaths, the sheaths of *R. exaltata* being coarsely hispid.

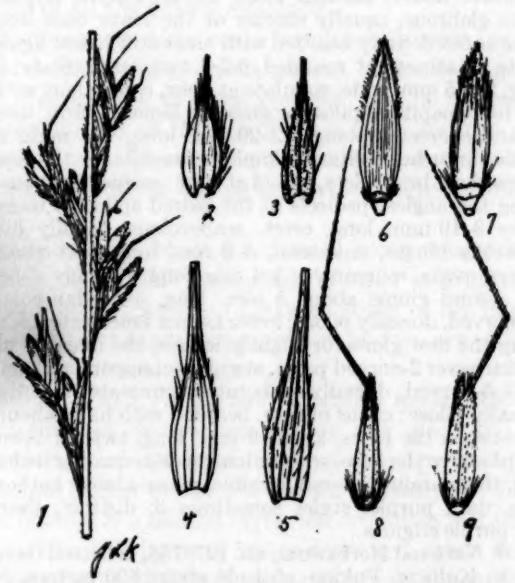

Fig. 3. *Arundinella bidentata* Keng.—1, part of raceme with 4 pairs of spikelets, × 2½; 2–3, ventral and dorsal views of the first glume × 7; 4–5, ventral and dorsal views of the second glume, × 7; 6–7, ventral and dorsal views of the lower floret, × 7; 8–9, ventral and dorsal views of the upper floret, × 7.

Arundinella bidentata Keng, sp. nov.

Perennis; culmi erecti, 50–70 cm. alti, glabri, 3–5-nodes, simplices v. a nodis inferioribus ramosi; vaginae laxiusculae, teretes, striatae, papillo-hispidae v. eae superioribus glabrae, nodis dense barbatis; ligulae membranaceae, 0.5–1 mm. longae, ciliatae; laminae e basi aequilata a vagina v. subrotundata lineares, subulato-acuminatae, 10–22 cm. longae, 2.5–5 mm. latae, papillo-pilosae v. inferne glabrae, firmae, saepe in sicco involutae; paniculae oblongae, 12–20 cm. longae, ramis erectis, solitariis v. iis inferioribus 2–3 nis; spiculae binatae, unilaterales, 5–6 mm. longae, pedicellis altero 1–5 mm. altero

3–10 mm. longis, scaberulis, versus apicem hispidis; gluma prima ovata, mucronata, 3–4 mm. longa, valde 3-nervis, hispida, subviolascens; gluma secunda circo 5 mm. longa, ovato-lanceolata, subulato-acuminata, 5-nervis, dorso pilosa; lemma inferius lanceolatum, tenuiter 5-nerve, superne pilosum, glumam primam subaequans, paleam acuminatum bicarinatam floremque masculam fovens; lemma superius oblongum, callo obtuso barbato 3 mm. longum, tenuiter 3–5-nerve, dorso scaberulo-punctatum, bidentatum, lobis laciniatis, dorso pilosis, e sinu aristam circo 6 mm. longam infra medium geniculatam exserens; palea lanceolata, ejus lemma aequans, marginibus inflexis, superne pilosis; antherae lineares, 1.2–1.8 mm. longae, saturate violascens; styli interdum 3, distincti, stigmatibus plumosis violascentibus breviores.

Perennial; culms, erect, 50–70 cm. high, 3–5-noded, glabrous, simple or branched at lower nodes; sheaths loose, terete, striate, papillose-hispid or the upper ones glabrous, usually shorter or the lower ones longer than the internodes, the nodes densely bearded with erect stiff hairs; ligule membranaceous, truncate or somewhat rounded, 0.5–1 mm. long, ciliate; blades linear, 10–22 cm. long, 2.5–5 mm. wide, subulate at apex, continuous with the sheaths or rounded at base, papillose-pilose or glabrous beneath, firm, usually involute when dry; panicle erect, oblong, 12–20 cm. long, the main axis angular, scaberulous, the branches solitary, simple, subsessile, or the lower ones 2–3-nate, with a few short branchlets, naked at base; rachis trigonous, scaberulous or ciliate along the angles; pedicels of the paired spikelets unequal, one 1–5 mm. the other 3–10 mm. long, erect, scaberulous, usually hispid towards the apex; spikelets binate, unilateral, 5–6 mm. long; first glume chartaceo-membranaceous, ovate, mucronate, 3–4 mm. long, strongly 3-nerved, hispid, dark purple; second glume about 5 mm. long, ovate-lanceolate, subulate-acuminate, 5-nerved, dorsally pilose; lower lemma lanceolate, membranaceous, about equaling the first glume or slightly longer, the margins hyaline, pilose above, with a narrower 2-nerved palea, staminate; upper lemma oblong, 3 mm. long, faintly 3–5-nerved, dorsally scaberulous-punctate, bidentate, the lobes laciniate, dorsally pilose; callus obtuse, bearded with hairs about 1 mm. long; awn arising between the lobes, about 6 mm. long, twisted below, geniculate about one-third above the base, scaberulous; palea equaling its lemma, lanceolate, 2-nerved, the margins inflexed, hyaline, pilose above; anthers linear, 1.2–1.8 mm. long, dark purple; styles sometimes 3, distinct, shorter than the plumose dark purple stigmas.

Type in U. S. National Herbarium, no. 1270758, collected on moist hillsides and open lands, Kuliang, Fukien, altitude about 800 meters, July 30, 1919, by J. B. Norton (no. 1154); the same species collected on Sharp Peak, mouth of Min River, Fukien, June 1924, by F. P. Metcalf and T. C. Chang (no. 60).

A distinct species, differing from all others in the upper lemma bidentate at apex, with the geniculate awn between the two laciniate pilose lobes. The species probably comes near to those of the subgenus *Miliosaccharum*, especially the common Asiatic species *A. setosa* Trin., in which, besides the awn there are two lateral setae. Except that *A. setosa* is usually glabrous, these two species resemble each other.

ANTHROPOLOGY—*The antiquity of man as indicated at Frederick, Oklahoma: A reply.*[1] HAROLD J. COOK, Cook Museum of Natural History, Agate, Nebraska. (Communicated by J. W. GIDLEY.)

In this JOURNAL, **20**: 475, 1930, Dr. O. F. Evans has contributed a criticism which brings up some points of interest in regard to the age of the deposits at Frederick, Oklahoma, wherein were found fossils and human artifacts, which we originally reported; and he has reached some conclusions which we feel do not accord with a comprehensive understanding of all the known evidence.

His description of the old stream bed in which were found the fossils and artifacts described in previous papers, is in close agreement with my original descriptions, in most respects, but he diverges widely in some of his conclusions on the age of these beds, and the value of their included fossils and artifacts as valid evidence; and in his interpretation of the time at which the stream which formed these beds, was active.

Some of the evidence which he cites as being conclusive on points which he makes, is quite as susceptible of other interpretation and so, at best, cannot be conclusive. Likewise some of his conclusions are based on inaccurate or unproven premises; and so, are either distinctly in error, or open to serious question.

To be specific. First, Dr. Evans recognizes three distinct phases of deposition in this old stream bed, (as we did, also) and says, "This (bottom) cross-bedded sandstone and conglomerate represents the early and normal period of the old stream's history." Then, "Above this old river bottom is a middle layer, ten or twelve feet thick. . . . ." Following, "Above this layer of water-deposited sands and gravels is an upper layer of several feet of material which appears to be partly water and partly wind deposited."

Anyone examining the extensive cuts in this bed at the Holloman quarries must be impressed that this division is present, and real. Yet in his conclusion Dr. Evans states: First; "It is a stream deposit," and second; "As a stream it was subject to disturbance at any time up to the time the stream left the valley." Obviously this implies that the division of the phases of the deposits he has just recognized are not determinable.

Further, he infers that, since the coarse materials in the middle bed show that an increase in velocity has occurred, it therefore follows that an uplift must have occurred to produce it. A much simpler

[1] Received March 7, 1931.

solution of the cause that would produce these effects is far more probable; namely; that a temporary climatic change occurred, with increased precipitation and increased stream run-off,—which is quite in line with well recognized habits of climatic cycles and fluctuations.

Now, let us return to the phases of stream deposit, and their portent. First, after over two years' intensive study of the large fauna found in these beds, which Dr. Hay and I recently reported upon, we found no difference in the age of the fossils from the various layers in this old stream bed. They obviously pertain to a relatively short period of time, and represent a comparatively contemporaneous fauna. Dr. Evans speaks of other gravel deposits in various other localities near the present Red River, which "contain numerous animal remains similar to those of the Holloman pit, such as tusks, thigh bones, etc., which appear, on casual examination to be what are generally referred to as of Pleistocene age." Does he mean to suggest that such *casual examination* and identification is of weight and value, comparable to the results obtained as a result of comparative studies by specialists, as a means of identifying the age of beds? I might suggest that "tusks, thigh bones, etc.," which, "on casual examination appear to be similar to those in the Holloman pit" occur in beds in stream deposits in which the writer has worked for over twenty years with Dr. W. D. Matthew, and other specialists, and date back anywhere from the early part of Pliocene times, some five or six million years ago, to well up through the Pleistocene. *Casual examinations* are of no value in comparisons of this sort; while exact comparisons, based on an extended fauna, may become rather precise in their import.

Dr. Evans suggests a Post-Pleistocene age for this stream. Without stopping to analyze all of his evidence, let us consider one point. According to all available evidence, modern races of mammals have existed back that far, showing little change in that length of time. According to the most exact comparisons Dr. Hay and I have been able to make, *not one single bone found in these deposits, which is definitely determinable, is referable to a modern species.* The closest relations and comparisons are with fossils known to have lived in the first half of the Pleistocene (to put it conservatively). So, if this were a Post-Pleistocene stream, the fossils would, of necessity, have been preserved as fossils some half million years or more before the "Frederick River" rewashed them into its bed, (as it must have done under that hypothesis). Likewise, it is safe to assume that they would have become fossilized in the first half-million years, and have been excessively fragile, even as when found now. To anyone familiar with

stream deposits and with such fossils, the extreme improbability of their withstanding redeposition after fossilization, and still remaining in the condition in which we find them, is obvious, especially in the case of large and fragile specimens such as the *Glyptodon* carapace in the Oklahoma museum, which Evans cites. Instead of proving, as he evidently believes, that the lack of skeleton inside this shell proves redeposition, it actually proves the exact reverse! As any accurate field observer knows, who is familiar with the processes in life, such a dead animal would be eaten out of its shell, or the flesh would have decayed, as with modern turtles, and while yet tough and its bony segments firmly held by animal matter, it might be washed with little further damage into the muds of a stream and buried, as this specimen was found; but once there, for any length of time, it is utterly impossible that any erosion could move the specimen without scattering the parts of the shell, or losing and destroying them.

The scattering and erosion of the bones found in this bed is that common to all similar stream deposits,—in which whole skeletons are rare finds. The bones found are, so far as determinable, of mammal species known to be characteristic of the early Pleistocene, and a homogeneous assemblage.

Aside from other evidence to the contrary, if that "Frederick River" only a few thousand years ago, ran on what is now a high hill-top, then we must commend the wonderful selective wisdom it displayed in choosing for preservation in its bed *only* mammals characteristic of early Pleistocene times, and by no chance including the remains of any modern species, which surely must have lived along its course.

Dr. Evans states that reasoning from the finding of fossils and artifacts in the same bed "seems to be a case of trying to apply a line of reasoning that does not apply at all in the case of stream deposits." This statement is hardly in accord with known facts. It is true that in order to evaluate evidence found in stream channels, it is necessary to take into consideration all types of specialized evidence, including all geological and paleontological data available, with more care than in marine deposits; consequently these problems are primarily of a nature whose solution must inevitably be sought by specialists in the field concerned, and by those who do not loosely relegate all stream deposits, and all fossils casually examined, to the catagory of useless evidence.

As to the "Post-Pleistocene uplift," or disturbance, which Dr. Evans first postulates, and then uses as a basis for proof,—the existence of such an uplift is far from a settled fact. We know much of the general history of such streams, and the effects that widespread elevation

and disturbances of the levels of the earth's crust have had upon them; and while some such disturbances *did* occur, there yet remains much to be worked out regarding their history and effects. There is much excellent evidence available, however, to indicate that a general uplift did occur in the whole area, and extended for hundreds of miles, but that it occurred at a much earlier date than Post-Pleistocene, namely, about mid-Pleistocene time. We expect to cite and publish some of this evidence in another place.

The statement made by Dr. Evans that the kinds of metates and arrows found in these beds are of recent age, and are as good evidence of the age of the beds as are the fossils, is based on unproven presumption, from one angle, and lack of consideration of known facts, from another, if we leave present evidence out of consideration. May I inquire the nature of the evidence that is available to the school of thought above illustrated, from which it may be stated what the people of Pleistocene times in America, (assuming they existed here) did or did not use, or what was the extent of their knowledge or lack of it? Where has such evidence been discovered, outside of deposits of this character? As previously pointed out, analogies with the cultures of Europe are interesting; speculations may lead to important discoveries; but such considerations are not proof or evidence of demonstrable fact. In view of the endless examples of both precocious and persistent primitive races among animals known to vertebrate paleontologists, we see no reason to believe that such conditions may not equally well apply to mankind. With this in mind, on present evidence, who can say that a precocious hunting race of nomadic people may not have developed, and, following the abundant game of Pleistocene times, have used the natural, obvious implements that such a life would develop,—much as did modern nomadic plains Indians—and then, satisfied with that state, have maintained it as a nearly static cultural state indefinitely, while conditions permitted? The term "metate" as applied to the type of stone artifact found in the "Frederick River" gravels is perhaps misleading. Whenever any primitive people undertook to store food, it is obvious that drying to cure and preserve meats, roots, fruits, etc., would inevitably be the first and natural method. It follows, equally well, that, after it had dried until hard, such food would be difficult to eat, and it obviously follows that such people found that by placing hard, dry food on one stone and pounding it with another, the food could be rendered more palatable. This discovery, inevitably, would lead to the use of just such primitive "metates" as we find here. This method must have originated

independently many times in human history; and *by no means* can be considered conclusive proof of a modern culture.

As to the statement that calculations based on rates of erosion have no value,—this statement is, of course, absolutely arbitrary, and in excess of the facts. It is true that much is yet unknown as to the rates of erosion of this type, and the many factors which influenced it, but a good deal that is certainly significant and strongly indicative of the probable rates of erosion, is very definitely known. If such evidence is to be arbitrarily thrown out because it is incomplete,—then the same logic applied to anthropological evidence bearing on pre-basket maker races in America would leave it a rather desolate field. It seems to me that the *facts* are more likely to be arrived at, finally, if we give *all* evidence in all subjects that may bear on our problems, most careful consideration; and not attempt to rule out, arbitrarily, factors not in accord with our personal views, which, after all, may be wrong.

CONCLUSIONS

Dr. Evans cites some interesting data on possible river piracy, that may have affected the early history of the "Frederick River" and which should be carefully worked out and studied.

His conclusions as to the unimportance of the evidence from the standpoint of fossils is certainly in error, as are also his conclusions that no reliable data can be had on the age or association of beds of this character, by the data they furnish.

The statement of his conclusion that the artifacts found are necessarily modern, is based on inference, and not on definite knowledge,—and so is indeterminate. The statement that metates and artifacts of the same type are now found on the surface of that region, has no determinable value, pro or con. It is certain that quite similar artifacts have been used into modern times. It is also true that a large part of the old "Frederick River" bed has already eroded away, and that any old artifacts that might be in such a deposit, would, in all probability be found, picked up, as erosion exposed them at the surface, and, not improbably, used by any modern Indians that found them; and so, be scattered. Therefore, the finding of such artifacts on the surface proves nothing as to the age of these deposits, either way.

Dr. Evans' conclusions on a "Post-Pleistocene uplift" in this region are certainly open to serious question, and, from evidence at hand, are believed to be in error; hence it follows that conclusions based on this supposition are highly questionable.

The implication that the fossils of this bed must have been rede-

posited in their present state, is out of the question as a probability, as any one with long field experience with such deposits and fossils will know.

We have seen no evidence to disprove a far greater antiquity for this deposit than the Post-Pleistocene upon which Dr. Evans insists. There is abundant evidence, (such as the complete absence of modern mammals in this deposit, and the presence of a rich and diversified mammalian fauna, of extinct races typical of early Pleistocene times, and other confirmatory data) to support a distinct Pleistocene antiquity for this stream bed and its contents.

The writer feels that until more evidence is assembled, it is premature to say dogmatically that this is an Aftonian stream deposit, (though most of the evidence is suggestive of it); just as it is premature to call it modern. However, there is so much good evidence in favor of a Pleistocene antiquity for this bed, both from the standpoint of geology and paleontology, that it deserves the most careful, comprehensive study, undertaken to find out the real facts, with due weight given to all evidence.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

238TH MEETING

The 238TH meeting of the ACADEMY was held at the Cosmos Club, February 20, 1931, Vice-President CURTIS presiding.

Program. Dr. M. A. TUVE of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington spoke on the subject, *Artificial radium-rays from high-voltage tubes.* The address was illustrated with lantern slides.

All physical objects in the universe are made up of atoms, and the different kinds of atoms are made up of different numbers of electrons surrounding a heavy kernel or core called the atomic nucleus. Fairly complete information about these external atomic electrons has been obtained from studies of spectrum-lines and from other types of investigations, but there is only scanty knowledge about the nucleus. Most of what is known about atomic nuclei has been learned from two types of investigation, (1) from studies with radium and other radioactive substances, and (2) from measurements of the masses of individual atoms in the "mass-spectrograph," which gives information as to the components in the nuclei and their energies of binding. All available evidence clearly indicates that there are two fundamental atomic "building-blocks," namely, electrons and protons, the latter being hydrogen atom-nuclei. "Quanta" of electromagnetic radiation (light-waves) should justly be included as a third elemental building-block of the universe.

Radium and other radioactive elements emit three types of rays: Alpha-rays, which are the nuclei of helium atoms shot out with high velocities; beta-rays, which are high-speed electrons; and gamma-rays, which are very penetrating X-rays. The alpha- and beta-rays from radium have energies (represented by their velocities) as great as they would acquire had they been accelerated from a state of rest by electric potentials ranging in magnitude from one hundred thousand to several million volts. The gamma-rays have energies of the same order of magnitude although they are electromagnetic waves and have velocities identical with that of light. By studies of these rays and their interaction with other atoms much information of a fundamental nature has been obtained concerning atomic nuclei. In the lecture typical experiments, including the recent ones of Pose, were described and their interpretation indicated. Since radium and other radioactive sources are available only in limited quantity and, what is more important, the energy-range of the emitted rays is distinctly limited, it has been clear for many years that the development of a controllable artificial source of such rays would greatly extend the scope of such studies.

An effort to develop such a source of artificial "radium-rays" was undertaken in the Department of Terrestrial Magetism, of the Carnegie Institution of Washington, in 1926 by Dr. Gregory Breit of the ACADEMY and the lecturer, using the potentials of several million volts produced by Tesla coils. Messrs. L. R. Hafstad and O. Dahl of the Department's staff have

taken a large part in the work. The development of suitable vacuum-tubes for such high voltages was finally achieved along lines similar to those first used by Dr. W. D. Coolidge, namely, by dividing the voltage among separate vacuum-tubes connected in cascade, with an inner hole extending through all tubes. Some of the technical difficulties encountered in operating vacuum-tubes at very high voltages were described.

During the past year such tubes have been used in the laboratory of the Department with Tesla voltages up to approximately two million volts, and measurements have been made to verify the production of artificial beta-rays (high-speed electrons) and gamma-rays (very penetrating X-rays) by the tubes. The beta-rays were measured by their deflection in a calibrated magnetic field. The maximum speed of the electrons measured in this way checked the measurement by the capacity potentiometer-method of the maximum voltage applied to the tubes, thus verifying the previous voltage-measurements on the Tesla coils. The gamma-rays from the tubes were measured through one, two, and three inches of lead, using a Geiger-Müller tube-counter. With a peak-voltage of 1,300,000 volts on the tube the absorption-coefficient of the gamma-rays from the tube after filtering through one inch of lead was found to be very nearly the same as the absorption-coefficient of the gamma-rays from radium after passing through the same filter. Since most of the beta- and gamma-rays from radium have voltage-equivalents under 1,000,000 volts, and nearly all lie under 2,000,000 volts, the artificial production of beta- and gamma-rays practically covering the radium-spectrum has been achieved. The artificial production of the alpha-rays (high-speed helium nuclei) has not been attempted. Instead, experiments on high-speed protons (hydrogen nuclei) are in progress because results with them will be even more directly interpretable than similar results with helium nuclei. (*Author's abstract.*)

CHARLES THOM, *Recording Secretary.*

PHILOSOPHICAL SOCIETY

1012TH MEETING

The 1012th meeting was held in the Cosmos Club Auditorium on November 22, 1930, President LAMBERT presiding.

Program: MALCOLM P. HANSON: *Radio with the Byrd Antarctic Expedition.*—With the aid of about sixty lantern slides, the speaker described experiences and conditions encountered on the Byrd Antarctic Expedition during its various phases, with particular reference to radio communication and research. After pointing out the difference between the Antarctic pack ice belt, the Ross Ice Barrier or, more appropriately, the Ross Ice shelf, and the saltwater Bay ice, the speaker described the establishment of "Little America" ten miles from the water's edge, which required the transporting of five hundred tons of supplies over this distance of rough ice through months of dog sled hauling. Construction of the radio towers and other radio facilities around the camp was described, and the extensive use of radio shown to be of fourfold use to the Expedition, namely for safety, efficiency, scientific research, and morale of the personnel. The speaker showed how the long winter night was spent in thorough preparation for the spring's coming exploration activities; improved light-weight sledges were built, harnesses and clothing prepared, foodstuffs weighed out and packed, airplanes and radio facilities improved, and many other things accomplished. The peculiar radio conditions

encountered during this period, such as rapid fading and multiple echoes, were studied largely by means of oscillograms. Determinations of height and condition of the Kennelly-Heaviside layer were instituted by transporting and setting up the receiving equipment and oscillograph on several trips, five to ten miles from Little America, and taking runs over at least 24 hours on special signals sent out from the base, over a wide frequency range.

The need for ski practice and a certain amount of outdoor exercise despite the darkness and temperatures which went to −72.8°F., caused installation of a powerful beacon light atop one of the radio towers to help guide anyone back to camp who might get lost in darkness or blizzard; a group of additional small flashing lights was in everyday use and conveniently showed the location of camp to men out walking. Ryme, fog, and even a light rain were experienced in sub-zero weather, and ice crystals in the air gave rise to many beautiful phenomena. Daily radio messages and news bulletins from various parts kept the expedition in touch with the world and radio concerts were frequently received and helped to break the monotony.

With the coming of spring, in October, the supporting party laid down depots every fifty miles for two hundred miles to the south, and with the newly-constructed portable radio equipment, deriving its transmitting power from batteries or from a little hand-operated generator, was able to maintain regular radio contact with the base. The snowmobile party, which followed in its tracks, had a breakdown 85 miles from home, and had to walk back, pulling a sledge with their sleeping bags, tent, and emergency rations behind them. The geological party made a long dog sled trip to the south, covering over eleven hundred miles in three months, while maintaining regular radio communication with their portable set.

Many airplane flights were made for exploration and aerial mapping purposes, the chief ones being the base laying flight, the south polar flight, the eastern flight to King Edward and Marie Byrd land, and the western flight over the Ross Barrier. The speaker showed the radio equipment with which the planes maintained radio communication with the base during these flights, and explained the special radio safeguards at Little America consisting of a directional radio beacon and of a radio compass, both of which would have been of great assistance in guiding the planes back in case of thick weather. Such a condition, fortunately, never arose during a flight, thanks to the expert weather predictions of our meteorologists. In addition to frequent poor visibility due to lack of shadows or horizon in overcast weather the greatest difficulties in flying operations were the uncertainty of snow surface for take-offs when away from the base, and the need for laborious heating of each engine and its oil before it could be started. The ski landing gears functioned admirably, except on a few sunny days in mid-summer when the temperature rose to near the melting point and caused the runners to stick to such an extent that a scheduled photographic flight was postponed for colder weather in order to preclude damage on landing.

The unusually heavy pack ice belt prevented the expedition vessels which had set out from New Zealand from reaching the barrier party until the end of the summer, when the City of New York managed to get through the pack and, caught in a heavy storm, was carried 400 miles off her course to the westward before reaching Little America. In passing through the pack she had observed the ice already to be freezing together again due to the late season, so in order to minimize the chance of being caught in the pack she remained at the Barrier only long enough to take aboard the men, dogs, and

the most essential supplies, before heading north again. The planes, houses, and most of the supplies had to be left behind.

The scientific radio records brought back include some 1500 oscillograms and about 2000 radio log sheets, besides a great number of fading records which were taken in New Zealand. A detailed analysis of these data is now under way, and when completed should throw considerable light upon many phases of radio wave propagation. (*Author's abstract.*)

Discussed by Mr. HECK.

1013TH MEETING

The 1013th meeting, constituting the 60th annual meeting, was held in the Cosmos Club Auditorium, December 6, 1930, President LAMBERT presiding.

The treasurer reported expenditures of $2578.55 for the year, including the purchase of a real estate note and an item of $312.31 for printing the article on the 1000th meeting. He stated that the number of active members is 227.

The Secretaries reported that the following new members were elected during the year: Miss G. BACK, E. S. BELOTE, R. H. CANFIELD, G. W. GARDINER, L. W. HAFSTED, H. D. HARRADON, J. P. LUSHENE, R. J. SEEGER, K. L. SHERMAN, F. M. SOULE, O. W. TORRESON, C. B. WATTS.

The death of ASAPH HALL was reported.

The following officers were declared elected for the year 1931: *President*, H. L. CURTIS; *Vice Presidents*, L. B. TUCKERMAN and O. S. ADAMS; *Recording Secretary*, G. R. WAIT; *Treasurer*, N. H. HECK; *Members-at-large of the General Committee*, C. HUFF and W. D. SUTCLIFFE.

At the conclusion of the business meeting Dr. P. R. HEYL spoke on *A report on the redetermination of the constant of gravitation*—Three sets of measurements of the constant of gravitation were made, using the torsion balance in vacuum, with small masses of gold, platinum and optical glass. The results with the gold balls are open to some uncertainty because of an absorption of mercury vapor derived from the manometer in connection with the apparatus. The mean results are as follows:

Gold	6.678 ±0.003
Platinum	6.664 ±0.002
Glass	6.674 ±0.002

Weighting these in the ratio 1:3:3 the final mean is 6.670 ±0.005.

The difference between the values for platinum and glass is not to be ascribed to a variation of the constant of gravitation with the material. A special experiment to test this point was carried out with one platinum and one glass ball, using the method of Eötvös. No difference was found as great as one part in 10 million. (*Author's abstract.*)

Discussed by Messrs. PAWLING, LAMBERT, HAWKESWORTH, GISH, WRIGHT, and HUMPHREYS.

OSCAR S. ADAMS, *Recording Secretary.*

1014TH MEETING

The 1014th meeting was held in the Cosmos Club Auditorium, Saturday evening, January 3, 1931, President CURTIS presiding.

The address of the evening was given by the retiring President, W. D. LAMBERT, on *The variation of latitude.*

G. R. WAIT, *Recording Secretary.*

ENTOMOLOGICAL SOCIETY

422ND MEETING

The 422nd regular meeting of the Entomological Society of Washington was held at 8 p.m., Thursday, October 2nd, in Room 43 of the U. S. National Museum, ex-president J. A. HYSLOP presiding. There were present 27 members and 20 visitors.

The first communication on the regular program was a paper by AUSTIN H. CLARK entitled *Notes on the behavior and migration of the milkweed butterfly.*—The milkweed butterfly (*Danais plexippus*), which is normally not very common in the District of Columbia and immediately adjacent region, appeared in great numbers on September 17th and 18th in the meadows west of Cabin John following a heavy rain on September 16th. The individuals were observed to devote themselves wholly to feeding, becoming increasingly sociable, for about three days. On September 20th they became restless and a few were seen high in the air passing toward Great Falls (west) before a moderate wind. Their numbers in the fields had decreased, and those that remained showed a desire to rest on trees instead of among the goldenrods and asters as they had done previously. On September 24th they appeared in Washington, becoming frequent in all parts of the city on the following day. On September 26th only about a dozen were found in the fields, and all of these had certainly been less than a week on the wing. Nothing in these observations indicates any departure from the normal life of the adult of this butterfly—about three days of intensive feeding followed by a much longer period of wandering and later of reproduction combined with wandering. At any time during the summer the insects may be observed, as individuals, flying at a great height. From this general region two migrations have been reported. In one the butterflies were flying south against the wind and in the other they were flying north with the wind. Those we saw were flying west with the wind. Most of the migrations which have been reported, however, have been southerly, especially in the central part of the continent. It was suggested that the migrations of this butterfly are in reality mere aimless wanderings having their inception in the simultaneous appearance of large numbers of individuals which happen to reach the wandering stage at the same time, and further that these migrations take their direction primarily from the prevailing meteorological conditions of the season and secondarily from geographical features, especially rivers and the sea coast. In other words, the migrations of this insect are simply the mass expression of the normal habits of the individual at all times. It was pointed out that the butterflies commonly seen in groups on muddy spots—in this region especially *Colias philodice* and *Eurema lisa* and not far away also *Catopsilia eubule* and *Eurema nicippe*—are almost exclusively fresh males, and that with the coming in of a new brood the insects appear in numbers on mud before they do in the fields. In the exceptionally dry summer of 1930 when all butterflies were scarce, no butterflies frequented the puddles at Cabin John, whereas in the previous normal year puddle butterflies had been common, even soon after a rain. It was deduced from the evidence that the butterflies about puddles are surplus males which have been driven out of the fields by persecution by older males at the time—immediately following emergence from the pupa—when they normally occupy themselves chiefly in intensive feeding, and that the appearance of puddle butterflies is therefore caused by overcrowding in the areas where the food plant is found and wherein the females more or less constantly remain. In the absence of the rivalry incited by the presence of females the young males of these

pierids become gregarious. A large proportion of these males probably go back to the fields as the older males die off. But there is an unassimilible surplus, and it is probably from this unassimilible surplus, consisting of males that have been driven out into the regions devoid of females that the migrating swarms of these and related pierids are composed. These swarms fly in a more or less straight line against the wind just as single traveling males of the species concerned are often seen to do. On the Atlantic seaboard in the late summer *Catopsilia eubule* is sometimes observed migrating northward at the same season when, and in the same places where, *Danais plexippus* is migrating southward. In the fields at Cabin John where *Danais plexippus* was noticed going west with the wind toward Great Falls *Catopsilia eubule* is occasionally seen at the same season flying directly east against the wind. Unless the migrations of these pierids and the danaid are to be explained as a collective expression of the normal actions of the individuals of the species concerned, it is difficult to understand why two primarily tropical species—*Danais plexippus* and *Catopsilia eubule*—should migrate in opposite directions at the same season. (*Author's abstract.*)

This paper was discussed by HYSLOP, LARRIMER, BUSCK, HADLEY, and HOLLAND.

The second communication on the program was given by S. A. ROHWER and was entitled *Remarks on the present status of some insect pests which are subject to federal quarantine.*—By the use of lantern slides the speaker discussed outstanding events connected with regulatory and control work on the Mexican fruit worm, Gipsy moth, Satin moth, Japanese beetle, Mediterranean fruit fly, and the European corn borer. In discussing the work on the Mexican fruit worm he pointed out that no infestation of this pest was known to exist in the United States. The last incipient infestation was discovered in Brownsville on November 19, 1929 and was confined to a few trees on two residential properties. Following this discovery intensive control and cleanup work was inaugurated and spraying operations were carried on in United States until March, 1930, and are still being carried on in Matamoros in coöperation with the Mexican Government. Traps are being used as an aid in detecting presence of the fly both in the United States and in Mexico. Referring to the work on Gipsy moth, the speaker discussed briefly the infestation which was found on Long Island in November 1929, adding that this infestation was now under control and that no recent evidence of infestation had been found. He also stated that shipments made from the nurseries where infestation was known had all been traced and only one showed evidence of infestation and that was a single dead egg cluster which was located at Interlaken, New Jersey. Work done during the summer indicated that the Satin moth occurred over a considerably larger territory and that in some areas it has caused a rather intensive defoliation. A map showing localities where the Japanese beetle had been found as a result of scouting during the summer was also exhibited and explained in some detail. In discussing work on the Mediterranean fruit fly the speaker explained methods used in making intensive inspections over the State and stated that no infestation had been found since two pupae were discovered in soil under fallen fruit in a yard at St. Augustine on July 25, 1930. To show the thoroughness of the inspection work figures indicating the number of specimens which were referred for identification were given. It was pointed out that these specimens consisted largely of dipterous larvae which could not be separated from Mediterranean fruit fly larvae by any one other than a specialist. In discussing the work on the European corn borer the author used maps showing the distribution of the

corn borer as determined by scouting which was done during the summer of 1930. The apparent reduction in abundance of the corn borer in the area in which it was known to occur was also briefly discussed. (*Author's abstract.*)

This paper was discussed by LARRIMER.

Remarks were made on invitation by Dr. W. J. HALL, a visitor from the British South African Company of Rhodesia, S. Africa, who expressed his pleasure at being with us and who gave us a brief resume of his work during the past four years on insect pests of citrus plants in South Africa. The major pests discussed by him were the citrus thrips, *Scirtothrips aurantii* Faure, and the Citrus aphis, *Aphis taveresia* Del. Wg.; red scale, *Aonidiella aurantii* Mask.; the cotton bollworm, *Heliothus obsoleta* Fab.; and the Mediterranean fruit fly, *Ceratitis capitata* Wied. He also made mention of some of his entomological work covering a seven-year assignment in Egypt. His itinerary included visits to Florida and California and an extensive study of our research and quarantine work on citrus pests.

Dr. MORRISON reported briefly on the recent safe arrival at the National Museum of the famous Barnes collection of Lepidoptera concerning which a more detailed discussion will be given later in the year,—probably by Mr. BUSCK.

Brief greetings also were extended to the society by two other visitors, Professor FRENCH, State Entomologist of Virginia, and Dr. M. W. BLACKMAN, formerly of Syracuse University, Syracuse, N. Y., now of the U. S. Bureau of Entomology, Washington, D. C.

Dr. J. M. ALDRICH discussed briefly the present procedure of our society in publishing its minutes in the Journal of the Washington Academy of Sciences rather than in the proceedings of the Entomological Society of Washington, and stated that he would discuss this matter more fully at a subsequent meeting.

423RD MEETING

The 423rd meeting of the Entomological Society of Washington was held at 8 p.m., Thursday, November 6, 1930, in Room 43 of the new building of the National Museum, President J. E. GRAF presiding. There were present 42 members and 35 visitors.

The following individuals, all connected with the Bureau of Entomology, were admitted to membership: Mrs. MARGARET C. MANSUY, Miss LOUISE M. RUSSELL, Miss IDA WECKERLY, Dr. M. W. BLACKMAN, and Mr. P. W. OMAN.

The first communication on the regular program was given by ROBERT E. SNODGRASS and was entitled *From an egg to an insect.* The paper comprised a resumé of the principal facts on record concerning the subject. A considerable number of slides were shown and explained in detail. The paper was discussed by MCINDOO.

The second communication on the program was a talk by Prof. S. W. FROST of Pennsylvania State College on *Animal life on Barro Colorado Island.* —Barro Colorado is the largest island in Gatun Lake, Panama. It was set aside by the governor of the Canal Zone in 1923 as a preserve where any qualified scientist could have an opportunity to study the wild life of a typical rain-drenched tropical jungle. The island is conveniently reached by train from Panama City or Colon. Descending at the little waystation, Frijoles, where bananas are usually in evidence, the scientist is taken by launch across the canal, a distance of about three miles, to Barro Colorado Island. Here the scientist finds shelter, a comfortable bed, good food, tables and all the

necessary equipment for general investigation. Knowing that all the essentials and comforts of life are abundantly provided for, he can direct his entire time and attention to the sole purpose for which he came. Botanists, ornithologists, entomologists, zoologists and many others have availed themselves of the excellent opportunities made possible through the efforts of the local custodian, Mr. James Zetek, and through the zeal of Dr. Thomas Barbour and others who have spent unlimited time in planning and developing the laboratory. In addition to the two story laboratory building, there is a guest house for visitors, and Dr. Frank Chapman has a small house of his own. At the far side of the Island, on the Drayton and Allison Armour trails, one-room shacks have been built, known as termite houses for they are a part of a project to determine the resistance of different building materials to termite injury. They also serve as shelters when one is working on this side of the island. They are stocked with provisions, provided with cots and blankets and ready to serve the scientist at any time. Here the writer was the first to sample tea after the rainy season and being very thirsty drank a cupful almost in one draught only to find that it was miserably musty. This, however, was offset by a fine fish hooked just a few feet from the steps of the shack. He did not recognize the fish and no one will ever know what species it was. The island has an area of about six square miles and is, for the most part, densely covered with vegetation. A small clearing has been made near the laboratory where bananas, pineapples and a few other plants are grown. The western half of the island is virgin forest of the finest description. The elevation at the center is only 452 feet above the level of the lake; still one finds travelling strenuous enough on some of the trails and impenetrable in places, when off the trails. There are over twenty-five miles of trails leading from the laboratory to various points on the shore line. The trails are named after scientists as "Wheeler," "Barbour," "Zetek," "Shannon," or after benefactors as "Allison Armour." They are uniquely marked every ten meters by a metal tag fastened to a tree. This makes it very easy for visiting scientists to find their way and convenient in reporting things of interest, along the trails. The large trees always attract attention. Bombacopsis sometimes attains a circumference of 190 feet at the base, including the great buttresses, and towers 150 feet above the forest floor. Here the howlers like to roost far from the danger of other animals. Adjacent to the laboratory a magnificant group of trees rise 100 feet from the edge of the lake. The American Museum of Natural History features a habitat group which does justice to these trees with their twining lianas and abundant bird life. It was here that the writer had his first glimpse of Barro Colorado Island. Great clumps of epiphytes, aroids, bromeliads and orchids frequently adorn the bare limbs of trees. From the laboratory we could see a limb supporting a world of life itself. Individual plants, some perhaps new to science, could be distinguished with field glasses, but the tree was too tall and too remote in the jungle to be conveniently reached by man. The plants of special interest to the writer were the hosts of leaf-mining insects. They ranged from the low growing weeds to the tallest trees. Nearly three hundred specimens were brought back and twenty-five new plant records added to the flora of the island. Animals and birds were abundant and, as hunting was prohibited, they were unusually tame. From the laboratory alone, two or three species of monkeys were frequently seen. The coati often came to feed at the garbage pile or climbed the papaya to steal fruits. The puma was heard not far distant from the laboratory on several successive nights and finally took its own picture by flash light for Dr. Chapman. The birds were too numerous and interesting to pass with a

few words. Some made indelible impressions on our minds that will last forever. The familiar sound of the dropping of heavy dew from the trees at dawn or the notes of the goat sucker will always recall mornings when we awoke refreshed for our work. The muffled notes of the owls greeted us as Dr. Chapman remarks, "bidding the day 'Good night'." Along the trails the noisy toucans and guans frequently startled us. The wrens and the oropendulas provided us with more pleasant music. Towards the close of day the parrots and parakeets amused us as they flew from tree to tree getting ready to settle down for the night. He who travels cautiously on the trails is sure to see and hear many animals and birds even though he be an entomologist with his whole nervous system fastened on a tiny insect just ready to take flight. The coati was seen more frequently than any of the other animals. One day in making a turn on Fairchilds trail the writer came upon three coati feeding upon the inner fleshy pulp that surrounds the seeds of the monkey comb (*Apeiba aspera*). Some other animals, possibly parrots, had been feeding there before and had split open many of the pods. The seeds missed by the parrots and avoided by the coatis, yielded a new species of Bruchid for the entomologist. The collared peccary was seen on many different occasions. One day the writer watched about twenty-five file across the trail fifteen feet ahead of him. As the last animal passed, the writer raised his insect net, the animal paused for a moment then slowly walked away. At the next bend in the trail he came upon the same herd of peccaries. They were travelling nearly in a straight line while the writer was following the crooked trail. Again he waited for them to pass and at the same time took a few motion pictures. The larger animals as the puma, the tapir and the deer are seldom seen. Dr. Frank Chapman has the distinction of being the only one that has seen a puma on the Island. He has however taken many excellent pictures of pumas, ocelots and tapirs in the low wet places on the Island. Whoever spends a little time on the Island soon becomes acquainted with the monkeys. The howlers take to the tree tops and are more frequently heard than seen. The passing airplanes disturb their peace and they set up a terrific roar. The white faced monkeys are encountered more often. They are inquisitive little fellows and are as anxious to see their peculiar relatives as we are to view them. By remaining quiet they would play about the branches for a long time, peer down at us and even descend to a lower level in hopes of getting a better view. A little noise or motion disturbs them and they go scampering over the tree tops with more agility than man walks on the ground. Along the shores of the island the basalisks and iguana were seen frequently. The basalisks were especially numerous. They were difficult to locate for they had the habit of remaining perfectly quiet for a long period of time and blended well in color with their background. When disturbed they skipped over the water with tremendous speed. With a little care one could paddle a cayuca within eight or ten feet of them. There is no doubt that one can see more tropical life on Barro Colorado Island than by penetrating the average jungle, for the trails are used by animals as well as man and further permit man to travel noiselessly and easily to remote parts of the island. It is remarkable to think of such a comparatively small bit of land housing such a large fauna and flora. All visiting scientists have found its climate enticing and its resources unlimited.

Several reels of motion pictures were shown covering various phases of animal and plant life on the Island.

424TH MEETING

The 424th regular meeting of the Entomological Society of Washington was held at 8 p.m., Thursday, December 4, in Room 43 of the new building of the

National Museum, President J. E. GRAF presiding. There were present 31 members and 11 visitors. Mr. W. D. REED, of the U. S. Entomological Laboratory at Danville, Va., was elected to membership on recommendation of the Executive Committee.

A motion was offered by Dr. J. M. ALDRICH as follows: Moved, that the Executive Committee be instructed to arrange for the publication of the minutes of our meetings in our own Proceedings hereafter, beginning with the January meeting. In commenting on the motion, Doctor ALDRICH stated that the minutes of the society for several years past have been published in the Journal of the Washington Academy of Sciences and that such procedure appeared inconsistent with the fact that our only publication was entitled "Proceedings." He read some comparative figures regarding space requirements and publication costs, and indicated that he for one would be willing to aid pro rata in whatever increased cost of publication the adoption of this motion might entail. After comments by EWING, HYSLOP, and ROHWER, the latter speaking against the motion, the society voted 12 to 11 in favor of the motion.

The following were elected officers of the society for 1931: *President:* A. C. BAKER; *First Vice-President:* F. C. BISHOPP; *Second Vice-President:* C. T. GREENE; *Recording Secretary:* J. S. WADE; *Editor:* W. R. WALTON; *Corresponding Secretary-Treasurer:* S. A. ROHWER; *Representative of the Washington Academy of Sciences:* H. MORRISON; *Executive Committee:* The officers and T. E. SNYDER, A. N. CAUDELL, W. H. LARRIMER.

During intervals in the election of officers, a note was presented by Dr. W. D. PIERCE on *The mango weevils.*—A number of species of weevils breed in the seed of mango in the Orient, and as they have not all been listed in their proper genus it is well to publish the following notes on the synonymy of the genus *Sternochetus* to which four of the mango weevils belong.

Genus *Sternochetus* (Kolbe) Hubenthal (1915)

Sternochetus (Kolbe) Hubenthal (1915) Ent. Mitt., **4**: 128, type *mangiferae* Fabricius. Below is cited the synonymy of the mango weevils which may be assigned to this genus:

Sternochetus mangiferae (Fabricius) Hubenthal

Curculio mangiferae Fabricius (1792) Ent. Syst., **1²**: 432, No. 161.

Rhynchaenus mangiferae Fabricius (1801) Syst. Eleuth., **2**: 473, No. 173.

Cryptorhynchus mangiferae Schönherr (1826) Curc. Disp. Meth., p. 282; Boheman (1837) Schönherr's Gen. et Sp. Curc., **4**: 91.

Sternochetus mangiferae Hubenthal (1915) Ent. Mitt., **4**, No. 4–6, pp. 128, 129; Pierce (1917) Manual of Dangerous Insects, p. 144, fig. 72.

Originally described from seeds of mango in India orientalis. Recorded by Boheman from India orientalis, Bengalia, Java, He-de-France, Madagascar. According to Lefroy is confined to Southern India and Ceylon.

This is the species most commonly known as the Mango Weevil. It has ben written about by many authors and its habits are pretty well known. It breeds in the seed of the mango.

Sternochetus gravis (Fabricius) Pierce

Curculio gravis Fabricius (1792) Ent. Syst., **1²**: 435, no. 172. Cape of Good Hope.

Rhynchoenus gravis Fabricius (1801) Syst. Eleuth., **2**: 481, no. 203.

Cryptorhynchus gravis Stebbing (1914) Indian Forest Insects, p. 436, fig. 289.
Sternochetus gravis Pierce (1917) Manual of Dangerous Insects, pp. 143, 144, fig. 71.

Stebbing calls this the Northern Mango Weevil of India. The larvae first feed in the pulp and then enter the seed.

Habitat: United Provinces, Bengal, Assam.

Sternochetus frigidus (Fabricius) Pierce

Curculio frigidus Fabricius (1787) Mant. Ins. App., p. 381.
Curculio chinensis Olivier (1790) Encyc. Meth., Ins., **5**: 507, no. 166.
Rhynchaenus frigidus (chinensis) Fabricius (1801) Syst. Eleuth., **2**: 470, 471, no. 158.
Rhynchaenus chinensis Olivier (1807) Entomologie, **5**, no. 83, p. 175; tab. 8, fig. 97. The plate is referred to by Olivier (1790) and Fabricius (1801).
Cryptorhynchus frigidus Rosenschoeld (1837) Schönherr's Gen. et Sp. Curc., **4**: 115.
Cryptorhynchus frigidus Faust (1894) Ann. Mus. Genova, ser. 2, **14** (**34**): 287.

Fabricius records from Amboina; Rosenschoeld from India orientalis, Bengal, Java, Madagascar, New Holland; Faust from Burma.

Faust records it as bred from fruit of mango.

Sternochetus olivieri (Faust) Pierce

Cryptorhynchus olivieri Faust (1893) Ann. Soc. Ent. Fr., **61**: 518, 519.
Cryptorhynchus olivieri Faust (1894) Ann. Mus. Genova, ser. 2, **14** (**34**): 287.

Faust (1893) recorded it from Saigon and (1894) from Schwegoo (Burma).

It attacks mango in Java, material having been received from Buitenzorg, collected by Paul Vandergoot.

Sternochetus poricollis (Faust) Pierce

Cryptorhynchus poricollis Faust (1894) Ann. Mus. Genova, ser. 2, **14** (**34**): 287, 288.

Recorded from Burma. I have no definite host record on this species. (*Author's abstract.*)

Doctor ALDRICH mentioned receiving a letter from one of his acquaintances in the British Museum in London, advising that the entomological section recently has moved into new quarters on the ground floor, in which twice as much room is now available for entomological work. This was commented on by HYSLOP.

J. G. SANDERS, of Philadelphia, and E. A. RICHMOND, of Brockton, Mass., both visitors, on invitation greeted the society and expressed pleasure at being with us.

Mr. GRAF referred to the recent publication of a book by Doctor HOWARD, entitled *A history of applied entomology*, and this was discussed very briefly by LARRIMER and EWING.

AUSTIN H. CLARK commented briefly on some recent work performed by him in making photographs of butterfly wings and showed several specimens of his work. Comments were made on his remarks by GRAF, MORRISON, ROHWER, PIERCE, and HYSLOP.

The first communication on the regular program was given by Dr. H. E. EWING and was entitled *The distribution and host relationships of ectoparasites, with special reference to chiggers.*—The distribution of fleas in North America was discussed and a map presented showing the localities in the United States

from which specimens of the human flea, *Pulex irritans* Linnaeus, have been taken. This flea occurs generally throughout the more humid parts of the Mississippi Valley, along the Pacific slope and in a restricted area in the Middle Atlantic States. The probable reasons for its absence from more than half the area of our country were discussed. Preliminary results of an ectoparasite survey of amphibians, reptiles, birds and mammals, of the South Atlantic Slope of the United States, were presented. This showed amphibians to be the most heavily parasitized of the four classes with chiggers, the per cent being 23.8. Mammals, on the other hand, had the highest percentage of infestation with all ectoparasites (57.1 per cent). The degree of infestation with ectoparasites for the four classes of vertebrates considered was shown also by plotted curves. Recent advances made by others concerning the distribution and host relationships of parasites were mentioned and discussed. Live specimens of some of the more important natural hosts of our common chigger, *Trombicula irritans* (Riley), were exhibited. (*Author's abstract.*)

A considerable number of slides and specimens of various animal forms were shown. The paper was discussed by HYSLOP, WADLEY, BISHOPP, ALDRICH, and PIERCE.

J. S. WADE, *Recording Secretary.*

(*Editor's Note.*—In accordance with action taken at the 424th meeting, further proceedings of the Entomological Society will be published in the Proceedings of the Entomological Society of Washington.)

GEOLOGICAL SOCIETY

471ST MEETING

The 471st meeting was held at the Cosmos Club January 14, 1931, President MEINZER presiding.

Program: Symposium on drought of 1930.

A. H. HORTON: *The Potomac River and the drought of 1930.*—The Potomac River is one of the larger streams in the United States which drain into the Atlantic Ocean. Its drainage area is larger than that of the Connecticut, Hudson, Delaware, James, or Savannah Rivers and about half as large as that of the Susquehanna River. The drainage area of the Potomac River at Great Falls is about 11,500 square miles—about 10 per cent less than the combined area of Massachusetts and Connecticut. The altitude of the basin ranges from sea level at Washington to about 3,000 feet at the divide on the south and west. The North Branch is considered the main stem of the river even though the drainage area of the South Branch is somewhat larger.

The average or normal annual precipitation of the basin is about 40 inches. The maximum annual precipitation of about 47 inches occurred in 1891. The minimum previous to 1930 was about 31 inches in 1895.

Records of the flow of the river at Great Falls or at Point of Rocks are available since 1896. During this period of about 33 years there were five large floods ranging from 175,000 second-feet to 265,000 second-feet, the largest of these being the flood of May, 1924. The maximum known flood, however, was that of June, 1889, which was caused by a rainfall on the basin of 5.3 inches in three days. The maximum discharge of this flood was about 390,000 second-feet at Great Falls, roughly 50 per cent larger than the flood of May, 1924. Storms with much greater rainfall have occurred along the Atlantic Coast, but fortunately they have missed the Potomac basin.

The rainfall on the Potomac River basin in 1930 was approximately 22

inches, about 55 per cent of the normal and about 35 per cent less than in the driest year previous to 1930. The mean daily flow at Great Falls for the lowest 7-day period in 1930 was 821 second-feet in August, 25 per cent less than the previous record, and the mean daily flow for the lowest month in 1930 was 870 second-feet in October, about 45 per cent less than the previous record. During the 33 years of record from 1897 to 1929, the flow at Great Falls was less than 1,000 second-feet for only 38 days, while in 1930 the flow was less than 1,000 second-feet for 83 days during the period August to October. This flow was almost wholly from underground sources for there was but little surface runoff, as the small amount of precipitation during these months was mostly absorbed by vegetation.

The supply of ground water has probably been seriously depleted and unless precipitation occurs this year under conditions favorable for replenishing the ground-water supply, the flow of the Potomac River during the low-water period of 1931 will probably be less than for 1930. In this connection, it should be noted that the flow for the minimum week of 821 second-feet was at least five times the amount needed for the city of Washington. (*Author's abstract.*)

Miss M. D. FOSTER: *The effect of the drought upon the quality of the water of the Potomac River.*—Two charts compare the fluctuations of discharge, turbidity and total hardness of the water of the Potomac River for a normal year (October, 1928–September, 1929) and for the period October, 1929 to December, 1930. In a normal year (as shown in the first chart) the discharge is relatively low in the fall, rises in the winter, with several high stages in the spring, decreases in June and July, and is again low in the late summer and fall. The turbidity, which is relatively proportional to the material in suspension, follows in a general way the discharge; any disagreements may be attributed to local rains which erode parts of the drainage basin more or less than an average amount. The hardness, plotted to indicate changes in quality, varies inversely with the discharge—being relatively high in the fall, low in the spring and increasing again in the late summer and early fall.

The second chart shows that the whole period—October, 1929 to December, 1930—was abnormal; high stages of the river in the fall, lower peaks than normal in the spring (a maximum of about 35,000 second feet in 1930 as compared with a maximum of 173,000 second feet in 1929), and after the middle of July a uniformly low discharge of 800–900 second feet until the last of December. With the earlier decrease in discharge the hardness of the water began to increase at an earlier date than usual and continued high longer, reaching a maximum of 136 parts per million, as compared with a maximum of 111 parts per million in the fall of 1929. The drought continued until the 27th day of December, when the hardness was 134 parts per million. On December 28, the hardness dropped to 31 parts per million, simultaneously with a rise in discharge greater than since April and with a great increase in turbidity. The increase in hardness with decrease in discharge may be attributed to the greater proportion of spring water present. (*Author's abstract.*)

Discussed by FERGUSON, E. S. HOPKINS, and DAVID WHITE.

CARL J. LAUTER: *Effect of the drought on filtration processes for the Washington water supply.* Discussed by HESS and BRADLEY.

W. N. WHITE: *Effects of the drought on wells and springs.*

Discussed by MEINZER, RUBEY, LAUTER, MCQUEEN, and THOMPSON.

H. B. HUMPHREY: *Influence of vegetation on stream flow during the drought.*—During the period September 1 to October 12, inclusive, daily observations on the rate of stream discharge were carried on by the author at his home in

Cabin John, Md. The stream, fed by springs, lies in a deep ravine and discharges into a small reservoir. In this ravine there were growing and drawing upon the water supply, at the time the readings were made, 32 trees of various species and sizes plus a fairly dense undergrowth of shrubs and annuals. It was observed that between 2:30 p.m. and 7:30 p.m. no water was discharging from the stream. Beginning at about 7:30 p.m. there was a mere trickle and the rate of discharge increased hourly until between 5:00 and 7:00 a.m. when it attained a maximum of 4.78 quarts per minute. This maximum flow was maintained until about 9:30 a.m. when it began to decline, ceasing altogether at 2:30 p.m. It was subsequently shown that this diurnal variation in stream discharge was directly related to the transpiration carried on by the dependent trees and associated plant growth. Factors, such as light and temperature, affected the water intake of the vegetation and registered their effect on the rate of stream discharge. Later, when the leaves fell from the trees and transpiration processes had ceased, the stream discharge rose to 6 quarts per minute and this rate has prevailed with occasional fluctuations due to rains. (*Author's abstract.*)

Discussed by MEINZER, SPENCER, HECKMER, MISER, and W. N. WHITE.

M. I. GOLDMAN: *Some biologic effects of the drought in tributaries of Chesapeake Bay.*—The paper was based on a report by Truitt and Algire, to the State Conservation Department of Maryland, on an unusual mortality of fishes in the Severn and Magothy Rivers. This report was very generously placed at the disposal of the speaker by Doctor Truitt.

The object of the paper was to bring out the fact that events like the drought of 1930 which, from the geological point of view, may be regarded as inherent factors in an environment rather than as catastrophic events, may account for sudden high mortalities of organisms such as might result in stratification surfaces covered with the remains of fishes or other organisms. The drought resulted in an upstream shift of salinity in Chesapeake Bay and its tributaries which, in the Susquehanna River amounted to about 30 miles, in the Potomac to about 16 miles. In small tributaries with small watersheds like the Severn and Magothy rivers the effect was even more pronounced. The mortality occurred between the 5th and 19th of November, 1930. The investigation by Truitt and Algire showed an increase of the salinity of these waters, (as indicated by the specific gravity) to about eight times normal, equivalent to a salinity about half that of normal sea water. Turbidity, pH, and other chemical and physical factors appeared normal. Seine hauls in areas in which fresh water fishes ordinarily abounded yielded only marine fishes which appeared perfectly healthy. The fishes affected were all fresh water forms. Parasitic marine isopods were found attached to the gills of most of the dead or dying fishes. There appears to be little doubt that, directly or indirectly, abnormal salinity, resulting from the drought, was responsible for the death of the fishes. (*Author's abstract.*)

Discussed by HECKMER, TRUITT, HOPKINS, and THOMPSON.

472ND MEETING

The 472nd meeting was held at the Cosmos Club on January 28, 1931, President MEINZER presiding.

Informal communications: W. H. BRADLEY compared certain fine-grained non-calcareous laminated marine sediments with recent laminated sediments of lacustrine origin, followed Rubey in interpreting the laminations in the marine sediments as probably varves resulting from a maximum summer pulse in the production of planktonic organisms, and pointed out that according to

this interpretation the laminations form a basis for estimating rates of sedimentation and intervals of geologic time.

M. I. GOLDMAN called attention to two outstanding sets of joints which control the course of the Potomac River near Great Falls, this effect of jointing being disclosed by a stereo-photograph compiled from airplane views.

Program: C. S. ROSS: *The Valles Mountain volcanic crater, New Mexico.*

Discussed by CROSS and MERTIE.

ADOLPH KNOPF: *The Engels copper district, California.*

Discussed by SHORT, LOUGHLIN, R. C. WELLS, and GREIG.

473RD MEETING

The 473rd meeting was held at the Cosmos Club on February 11, 1931, President MEINZER presiding.

Informal communications: W. C. ALDEN described large ripple marks occurring on the upstream end of a silt bar at the confluence of the Flathead River and one channel of the Stillwater River, 3 miles southeast of Kalispell, Montana. These marks were 5 to 15 feet from crest to crest by 8 to 12 inches deep, and were likened to forms described by Kindle as current ripples or mammoth ripples.

Discussed by MATTHES.

G. R. MANSFIELD showed a polished specimen of *Tempskya knowltoni*, a fern, from the Wayan formation of Cretaceous age in the Lanes Creek quadrangle, southeastern Idaho. The common fossil form consists of hundreds of stems entwined in a dense root net, the whole resembling fossilized wood.

Discussed by HESS.

Program: F. C. KRACEK: *Recent studies of alkali silicate systems.*

Discussed by GILLULY.

P. J. SHENON: *The Flathead mine, Montana, an unusual silver deposit.*—The Flathead mine is located 10 miles west of Flathead lake in Flathead County, Montana. It has produced over a million ounces of silver and considerable lead, and development work indicates even a greater future production. The region is underlain principally by flat lying Belt rocks of Algonkian age. Ten isolated patches of volcanic rocks, principally latite and trachyte tuffs and flows, rest upon the Belt rocks and two small exposures apparently represent outcrops of intrusive rocks. The latter are porphyrytic latites and enclose the ore at the mine. The most unusual feature of the intrusive rock is the size of its orthoclase phenocrysts, many of which are more than three inches long. In the ore many of the feldspar phenocrysts have been removed and are now represented by empty casts or casts which are partly filled with barite, silica, and in lesser amounts, a clay mineral and limonite. The ore occurs as an irregular body, 150 feet wide by 400 feet in length at its greatest dimensions. On the upper levels the ore body is roughly elliptical in horizontal plane. Vertical cross-sections show that the ore body somewhat resembles a molar tooth with one or more roots pointing downward. Inclusions of Belt rocks and irregular patches of brown nontronite mud occur through the ore.

The hypogene ore minerals include galena and a complex sulphide of silver, antimony, and bismuth, as well as pyrite and a little enargite. Argentite, covellite, and marcasite occur as supergene sulphides. Barite, quartz, clay, and alunite constitute the principal gangue minerals. More than one period of mineralization is evident. Quartz and pyrite first formed in the wall rock. Fractures were then developed which were healed principally by fine grained quartz, barite, and sulphides, in order of deposition. The evidence shows

that the deposit formed at a depth of less than 400 feet and probably nearer 200 feet below the land surface and that the outline of the cellular ore approximates the outline of the hypogene mineralization. Secondary enrichment has been a very important process in the formation of the commercial ore. (*Author's abstract.*)

Discussed by TUNELL, HEWETT, LOUGHLIN, and NOLAN.

E. O. ULRICH: *Highlights of the past season's work in early Paleozoic stratigraphy.*

C. H. DANE, ARTHUR M. PIPER, *Secretaries*

SCIENTIFIC NOTES AND NEWS

The twelfth annual meeting of the American Geophysical Union and of its Sections will be held April 30 and May 1, 1931 at the headquarters of the National Academy of Sciences, Washington, D. C. A seventh Section, known as the Section of Hydrology, has been formed in the past year and will hold its first meeting under the chairmanship of O. E. MEINZER.

The American Geographical Society, Carnegie Institution of Washington, Norwegian Geophysical Institution, Wood's Hole Oceanographic Institution and the Cleveland Museum of Natural History are cooperating in the preparations for scientific work to be undertaken by the Wilkins-Ellsworth Trans-Arctic Submarine Expedition.

Dr. J. BARTELS, Professor of Physics at the Forstlicher Hochschule of Eberswalde, Germany, who has been appointed a research associate of the Carnegie Institution of Washington for one year, will arrive in Washington, April 8. Dr. BARTELS will undertake a study in the Department of Terrestrial Magnetism of the interpretation of terrestrial-magnetic and electric data and laboratory methods.

S. L. SEATON, former observer and radio operator on the CARNEGIE, expects to leave during the summer for the Huancayo Magnetic Observatory, Peru, to install equipment for an experimental radio station for which an appropriation has now been made by the Carnegie Institution of Washington.

Obituary

Capt. HENRY MARTYN PAUL, U.S.N., retired, died on Sunday, March 15, following a long illness. Born at Dedham, Mass., in 1851, he graduated from Dartmouth College in 1873 and from Thayer School of Civil Engineering in 1875. He served as assistant astronomer at the Naval Observatory from 1875 to 1880 and again from 1883 to 1899. In the interim he was professor of astronomy in the Imperial University, Tokyo, Japan. It is believed that he was the first to introduce the study of astronomy into a Japanese University. In 1899 he was assigned to duty in the Bureau of Yards and Docks and in 1905 he was ordered to the Naval Academy, where he taught mathematics until shortly before his retirement in 1913.

Capt. PAUL was a fellow of the American Association for the Advancement of Science and a member of the Washington Academy of Sciences and of the Philosophical Society of Washington.